

PCT

**WORLD INTELLECTUAL PROPERTY ORGANIZATION**  
International Bureau



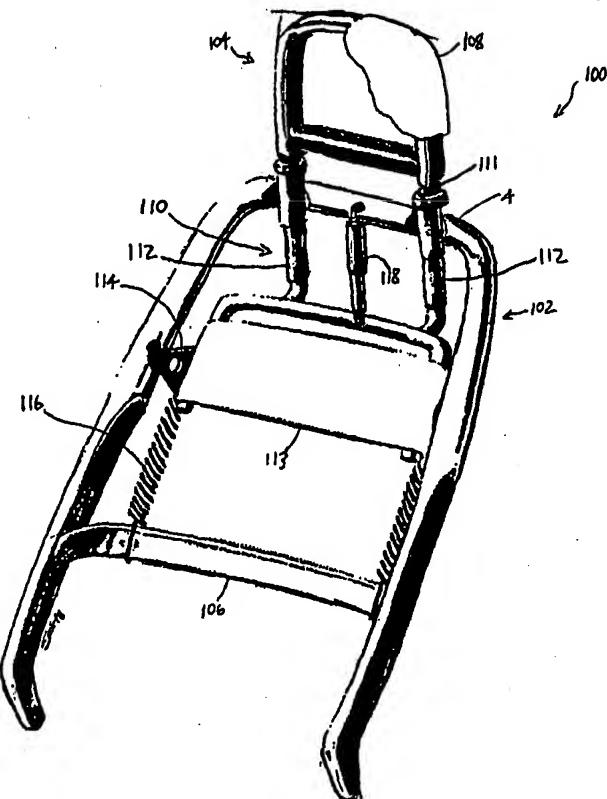
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 :  B60N 2/48		A1	(11) International Publication Number: <b>WO 00/35707</b>
(21) International Application Number: PCT/US99/29681		(43) International Publication Date: 22 June 2000 (22.06.00)	
(22) International Filing Date: 14 December 1999 (14.12.99)		(81) Designated States: JP, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).	
(30) Priority Data: 60/112,099 14 December 1998 (14.12.98) US		Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
(71)(72) Applicant and Inventor: HUMER, Mladen [US/US]; 24650 Saxony, East Pointe, MI 48021 (US).			
(74) Agents: STUENKEL, Mark, E. et al.; Brooks & Kushman, 1000 Town Center, 22nd floor, Southfield, MI 48075 (US).			

(54) Title: VEHICLE PIVOTAL HEADREST

**(57) Abstract**

A vehicle seat and headrest arrangement (100) includes a seatback frame (102) and a headrest (104) having a cushion portion (108) and an impact target (113) pivotally associated with the seatback frame (102). A rearward force acting upon the impact target causes the cushion portion to rotate forwardly. A spring (116) operatively associated with the headrest (104) and the seatback frame (102) biases the headrest against pivotal movement. The arrangement further includes a damper (118) operatively associated with the headrest (104) and the seatback frame (102).



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KR	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		

**VEHICLE PIVOTAL HEADREST****TECHNICAL FIELD**

This invention relates to seat headrest arrangements and methods of utilization thereof.

5

**BACKGROUND ART**

Headrests are known in the vehicle seating art. Examples of vehicle seat headrests can be found by review of Duvenkamp U.S. Patent No. 4,822,102 and Denton U.S. Patent No. 4,762,367. The present invention provides a vehicle seat headrest arrangement which provides an alternative to the aforementioned patents 10 with special unique advantages to be explained later herein.

10

**DISCLOSURE OF INVENTION**

15

Under the invention, a vehicle seat and headrest arrangement includes a seatback frame and a headrest having a cushion portion and an impact target pivotally associated with the seatback frame. A rearward force acting upon the impact target causes the cushion portion to rotate forwardly. A spring operatively associated with the headrest and the seatback frame biases the headrest against pivotal movement. The arrangement further includes a damper operatively associated with the headrest and the seatback frame.

15

20

With such an arrangement, the damper retards return movement of the headrest caused by the spring. Advantageously, the damper significantly decrease back driving of the cushion portion that may be caused by the head of an occupant during a rear collision.

20

25

According to a feature of the invention, the spring and the damper may be coaxially aligned with each other. Furthermore, the cushion portion may be configured to absorb energy.

These and other objects, features and advantages of the present invention are more readily apparent from the following detailed description of the best modes for carrying out the invention when taken in conjunction with the accompanying drawings.

5

### BRIEF DESCRIPTION OF DRAWINGS

FIGURE 1 is a perspective view of a vehicle seat and headrest arrangement according to the invention disclosed in U.S. Patent No. 5,378,043;

FIGURE 2 is an enlarged view of the headrest shown in Figure 1 with portions of a seatback cushion removed for clarity of illustration;

10

FIGURE 3 is a side view illustrating operation of the headrest shown in Figure 2;

FIGURE 4 is a perspective view of an alternate embodiment of the vehicle seat and headrest arrangement of U.S. Patent No. 5,378,043;

15

FIGURE 5 is a side view illustrating operation of the headrest shown in Figure 4;

FIGURE 6 is a schematic view of a vehicle seat and headrest arrangement according to the present invention and including a single damper connected between the headrest and a seatback frame of the vehicle seat;

20

FIGURE 7 is an alternative embodiment of the vehicle seat and headrest arrangement of the present invention including two dampers connected between the headrest and the seatback frame, wherein the dampers are coaxially aligned with a pair of springs;

FIGURE 8 is a front view of one of the dampers and one of the springs shown in Figure 7;

FIGURE 9 is a schematic side view of the arrangement shown in Figure 6 including an occupant;

FIGURE 10 is a schematic side view of the arrangement shown in Figure 6 and showing a headrest cushion of the headrest moved forwardly and  
5 contacting the head of an occupant; and

FIGURE 11 is a schematic view of an alternate embodiment of the headrest cushion of the headrest.

#### BEST MODES FOR CARRYING OUT THE INVENTION

The present invention is an improvement to the invention disclosed  
10 in U.S. Patent No. 5,378,043, which issued to Viano et al. The invention of Viano et al. '043 relates to a vehicle seat and headrest arrangement, which is described below in greater detail.

Referring to Figure 1 of Viano et al. '043, the vehicle seat and headrest arrangement 7 has a seat bun frame 3. The seat bun frame 3 has fore 5 and  
15 9 ends generally positionally aligned with the fore and aft segments of the vehicle in which the seat and headrest arrangements 7 is placed. Joined to the seat bun frame 3 generally adjacent its aft end 9 is a seatback frame 2. The seatback frame 2 is generally in the shape of an inverted U having two risers or sides 22 joined by a cross frame member 4. Typically, the seat bun and back frames 3, 2 will be made  
20 from steel, metallic or other structural members.

Providing a surface for contact with the head of a vehicle seat occupant is a headrest cushion 6. The headrest cushion 6 has extending therefrom two posts 8. An impact target or plate 10 is pivotally mounted to the cross member 4 along a fixed pivotal axis 13 generally perpendicular to the fore and aft direction of the vehicle. The plate 10 has two formed alignment members 12 for each  
25 respective post 8 for mounting of the headrest cushion 6 to the seatback frame 2.

The headrest posts 8 are adjustable vertically with respect to the plate 10 in a manner conventional for that of vehicle seat headrests.

The plate 10 mentioned previously is pivotally mounted with respect to the cross member 4 by virtue of its clamped ends 14. The clamped ends 14 are 5 joined to the cross member 4 by the use of a metal clip 16 which has flanges 26 that pop into apertures 15 (only one shown) of the clamped end 14. To stabilize the headrest cushion 6 in position and to prevent its rotation except at a threshold amount of force, there is a spring 18 which wraps around the intersection of the 10 risers 22 with the cross member 4. The spring 18 extends downwardly and is held to the plate 10 by clips 20. Rearward loading of the plate 10 will cause the headrest cushion 6 to pivot toward the head of a seat occupant. The loading required for pivotal movement of the headrest cushion 6 can be set to occur only during an instance where a vehicle seat occupant is seated in the seat and the vehicle undergoes 15 acceleration due to a rear impact-type situation. Alternatively, the spring 18 can be configured or sized to be easily movable at lower pressure levels and then plastically deform under predetermined loads representative of a rear impact-type situation. The pivoting of the headrest cushion 6 forwardly also has a beneficial effect of raising the relative height of the headrest 6 with respect to the seat bun frame from a height of 17 to 19 as shown in Figure 3.

20 Referring additionally to Figures 4 and 5, an alternate embodiment of the invention of Viano et al. '043 is brought forth with similar items providing the same function given like numerals as that shown in Figures 1 through 3. In Figure 4, the posts 30 are held to the cross member 4 by penetration through an elastomeric bushing 42, which is mounted in a clip 32 that is fitted on the cross member 4. The 25 posts 30 additionally extend downwardly, having loop sections 44 that are directed by two angular cam guides 46, which have a generally downward slope projecting generally forwardly. The impact plate 34 is attached with the posts 30 by four clips 48. A spring 18 biases the headrest cushion 6 against rotation by contact with the posts 30.

A force placed upon the plate 34 causes the posts 30 to have a variable axis of rotation with respect to the cross member 4, since the cam guides 46 will cause the posts 30 to rise upwardly after a sufficient force has been imparted to the plate 34. Also, the interaction of loop sections 44 with the cam guides 46 will cause 5 the headrest cushion 6 to be rotated slightly forwardly (Figure 5).

Upon a sufficient push on the plate 34, the posts 30 have an axis of rotation noted as 51. On a rear impact of sufficient magnitude, the posts 30 will be translated upward with respect to the clips 32, placing the headrest cushions 6 in a higher and more forward position. The axis of rotation 51 will be constant with 10 respect to the clips 32. However, the projection of the axis of rotation on the posts 30 at the initial impact will be translated to point 53 due to the extending upward motion of the posts 30. Therefore, the axis of rotation of the posts 30 with respect to the cross member 4 is nonfixed with respect to the posts 30.

In normal vehicle seat and headrest arrangements, during the initial 15 stages of a rear impact, the occupant's torso is in contact with the seatback but the head is several inches forward of the headrest. This condition is consistent with the body being reclined at about 20 degrees from vertical with the neck being approximately vertical. In contrast, the seat is usually at a reclined angle of approximately 25 degrees from vertical, and the headrest either follows the contour 20 of the seatback or curves slightly forward. However, for seating comfort, the head is usually not in contact with the headrest while driving. As the occupant loads the seatback in a rear impact, force builds up behind the torso and buttocks of the seat occupant. Depending upon the compliance of the seatback, the occupant compresses 25 into the cushion, but the head, neck and torso move in unison. Typically, there is a greater compression in the buttocks region of the seat occupant, with a gradual reduction up to the shoulder level as the body remains upright. The more severe the crash, the greater the compression of the occupant into the seatback. As this action 30 is occurring, the initial load of the occupant attempts to deflect the seatback rearwardly. The amount of deflection is related to the bending stiffness of the seatback. However, the seatback may possibly deflect under the torso load prior to the head and neck of the occupant contacting the headrest. Therefore, in a

conventional seat, there may exist a gap between the head and headrest in the crash situation. In the invention of Viano et al. '043, the force of the occupant's torso being cast into the seat causes the impact plate 34 or 10 to cause the headrest cushion 6 to rotate toward the vehicle occupant. The greater the rear crash acceleration, the 5 greater the resultant force on the seat occupant and the greater the forward rotation and outward movement of headrest 6. An additional advantage is found in the embodiment shown in Figures 4 and 5 in that the headrest cushion 6 and posts 30 move upwardly, thereby increasing the relative height or outward position of the headrest cushion 6 with respect to the seat occupant's head and minimizing any 10 possible gap between the head and the headrest cushion 6. The above action of the headrest cushion 6 provides a more idealized condition for taller seat occupants.

Referring to Figure 6, the present invention will now be described. A vehicle seat and headrest arrangement 100 according to the present invention includes a seatback frame 102 and a headrest 104 movably connected to the seatback frame 102. The seatback frame 102 is similar to the seatback frame 22, and includes 15 a lower cross member 106 in addition to the cross member 4.

The headrest 104 includes a headrest cushion 108 and an armature 110 for supporting the headrest cushion 108. The armature 110 includes posts 111 that are connected to risers 112, which are moveably connected to the cross member 4. 20 The armature 110 further includes a target 113 that is pivotably connected to the seatback frame 102 with links 114. The target 113 is configured to receive a load from a seat occupant, and may comprise any suitable material, such as a flexible, semi-flexible or rigid material. Sufficient rearward loading of the target 113, such as during a rear collision, will cause the headrest cushion 108 to pivot upwardly and 25 forwardly toward the head of the seat occupant, as shown in Figure 10.

Returning to Figure 6, the vehicle seat and headrest arrangement 100 further includes a pair of springs 116 connected between the headrest 104 and the cross member 106, and a damper 118 connected between the headrest 104 and the cross member 4. Similar to the springs 18 of the vehicle seat and headrest

arrangement of Viano et al. '043, the springs 116 bias the headrest cushion 108 against rotation.

The damper 118 exerts a damping force on the headrest 104. The damping force of the damper 118 is low as the armature 110 is actuated, and much 5 higher as the armature 110 returns. The headrest cushion 108 can be easily moved forwardly by hand. If the headrest cushion 108 is then abruptly released, the damper 118 slows down movement so that the headrest cushion 108 comes to rest with a softer noise compared with an arrangement provided without a damper. Thus, the damper 118 retards the return speed of the headrest cushion 108 and the armature 10 110.

In certain cases during a rear collision, the chest of the occupant might reach peak acceleration significantly before the peak of the head acceleration. As an example, the chest may begin its rebound just as the head is reaching its peak. Consequently, the chest force might not be high enough to support the head, which 15 might cause the head to push the headrest cushion 108 and the armature 110 rearwardly. The damper 118 significantly decreases this "back driving," improving the support for the head and reducing the load on the neck.

A single damper 118 may be placed between the seatback frame 102 and armature 110, as shown in Figure 6. Alternatively, as shown in Figures 7 and 20 8, two dampers 118 may be placed coaxially with the return springs 116 and connected to the frame 102 and the links 114.

The dampers 118 may be pneumatic or hydraulic units. Pneumatic devices may be more desirable, however, for several reasons: (1) air has less variation in damping force due to temperature than hydraulic fluid, (2) minor leakage 25 is not a problem and (3) a pneumatic unit is likely to be lower cost than a hydraulic unit.

Figure 10 shows the headrest cushion 108, which is preferably configured to absorb energy. The basic principle is to improve the Saab SAHR

headrest by providing some energy absorption to cause more even and controlled contact with the head during impact. This leads to quicker head support. Without such energy absorption, the head tends to oscillate after impacting a headrest cushion as shown in Figure 9.

5           Returning to Figure 10, the headrest cushion 108 may include energy absorbing foam 120 that is configured to dampen movement of the head of the occupant as the head contacts the headrest cushion 108. Alternatively, as shown in Figure 11, a headrest cushion 121 may be provided with a mechanical system 122 that provides both springing and damping effects. The system 122 includes a 10 flexible membrane 124 attached to a housing 126, which defines a chamber 127. The housing includes a rear member or plate 128 having a metered opening or hole 130, which allows the chamber 127 to be in fluid communicate with the atmosphere. The metered hole 130 may also be defined by a flow control valve attached to the 15 housing 126. The system 122 may also include a cover layer 132, which may include foam or other cushioning material, for providing a pleasing aesthetic appearance and for contacting the head of the occupant.

20           The membrane 124 may comprise any suitable material such as an elastic polymer, and is configured to flex into the chamber 126 when the head of the occupant exerts a rearward force on the headrest cushion 121, such as in a rear collision. The metered hole 30 is configured to allow air to easily exit the chamber 126, while restricting air flow back into the chamber 126 as the rearward force on the headrest cushion 121 diminishes. With such an arrangement, movement of the membrane 124 back to a rest position will be retarded. Consequently, head oscillation during impact or collision events is significantly reduced.

25           While embodiments of the invention have been illustrated and described, it is not intended that these embodiments illustrate and describe all possible forms of the invention. Rather, the words used in the specification are words of description rather than limitation, and it is understood that various changes may be made without departing from the spirit and scope of the invention.

**WHAT IS CLAIMED IS:**

1. A vehicle seat and headrest arrangement comprising:  
a seatback frame;  
a headrest having a cushion portion and an impact target pivotally  
5 associated with the seatback frame, wherein a rearward force upon the impact target  
causes the cushion portion to rotate forwardly;  
a spring operatively associated with the headrest and the seatback  
frame for biasing the headrest against pivotal movement; and  
a damper operatively associated with the headrest and the seatback  
10 frame.
2. The arrangement of claim 1 wherein the spring and the damper are coaxial.
3. The arrangement of claim 1 wherein the damper is a pneumatic  
damper.
- 15 4. The arrangement of claim 1 wherein the damper is a hydraulic  
damper.
5. The arrangement of claim 1 wherein the cushion portion of the  
headrest includes energy absorbing foam.
- 20 6. The arrangement of claim 1 wherein the cushion portion of the  
headrest includes a membrane adjacent a chamber that is in communication with the  
atmosphere.
7. A vehicle seat and headrest arrangement for use with a vehicle,  
the arrangement comprising:  
a seatback frame;

a headrest having a cushion portion and a target moveably associated with the seatback frame, wherein rearward loading of the target causes the cushion portion to move forwardly;

5 a pair of springs operatively associated with the target and the seatback frame for moving the cushion portion rearwardly after the cushion portion has moved forwardly; and

10 a pair of dampers operatively associated with the target and the seatback frame for retarding rearward movement of the cushion portion after the cushion portion has moved forwardly; wherein each of the dampers is coaxially aligned with one of the springs.

1/6

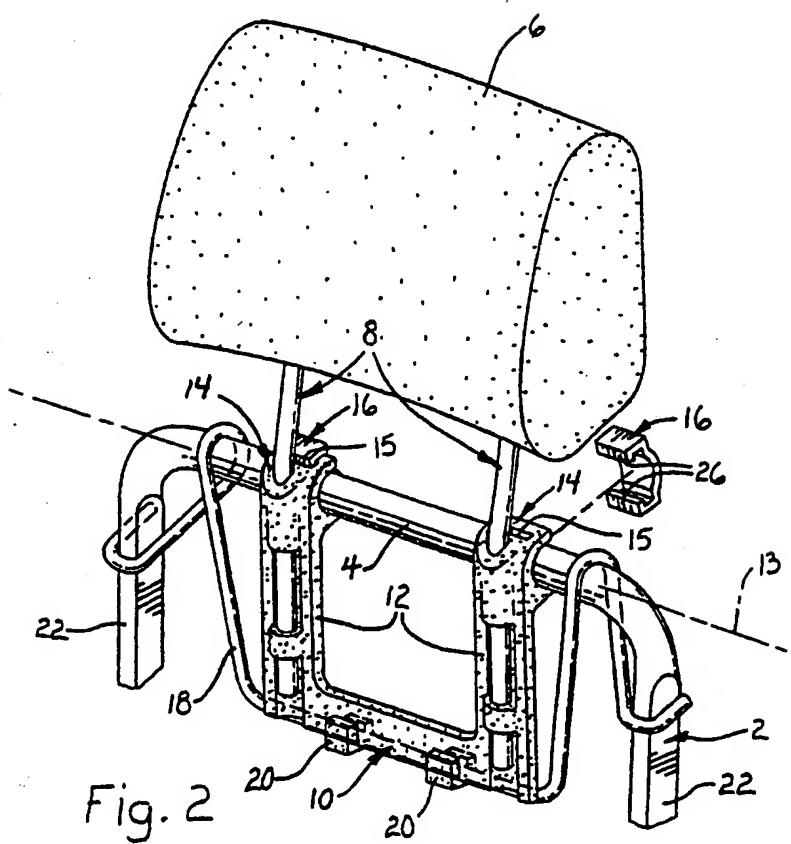
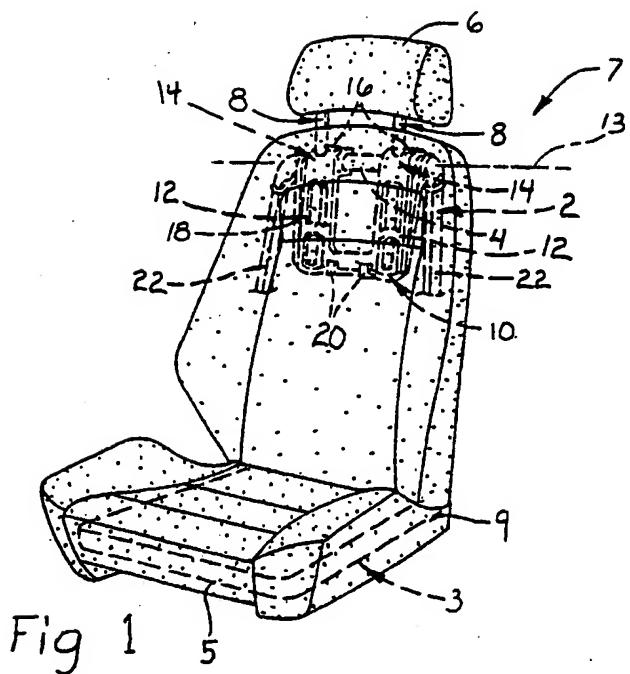


Fig. 3

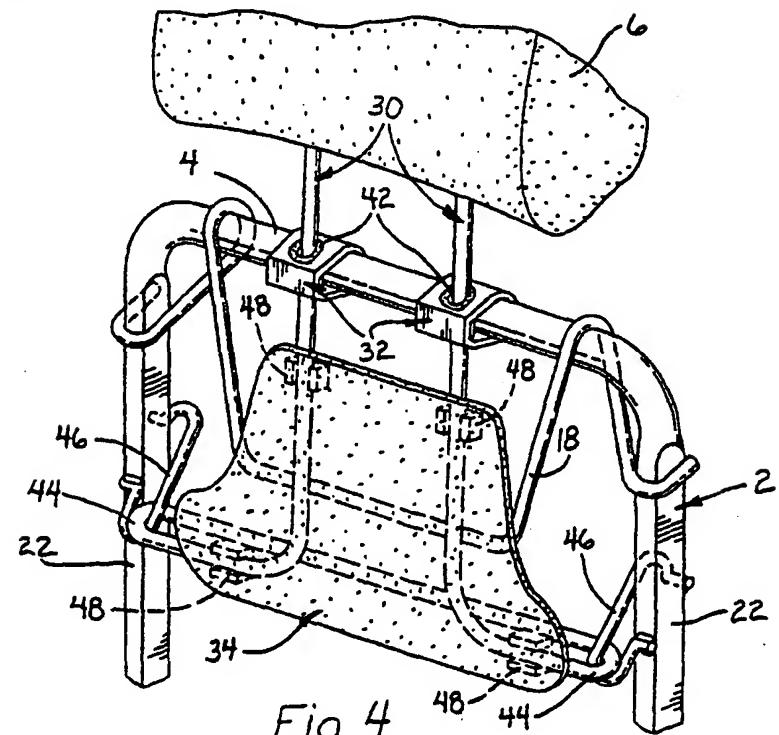
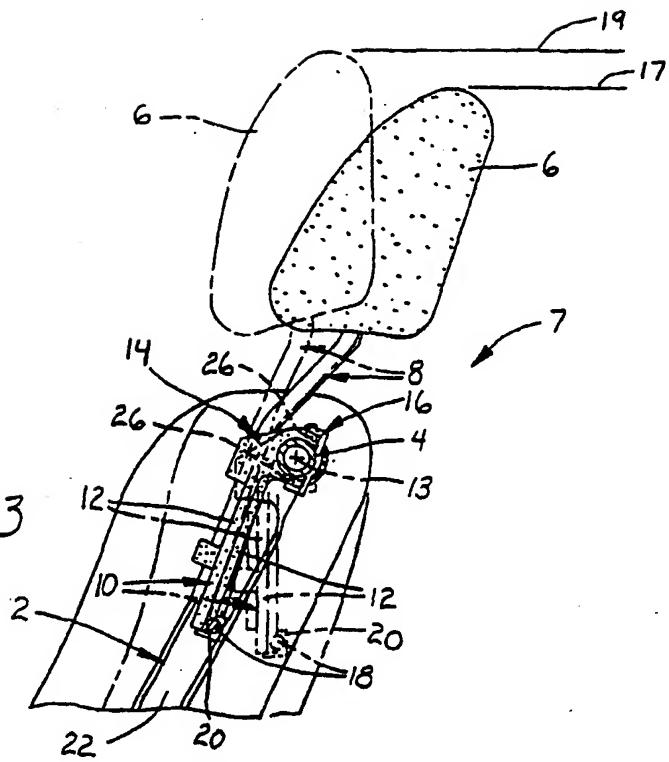
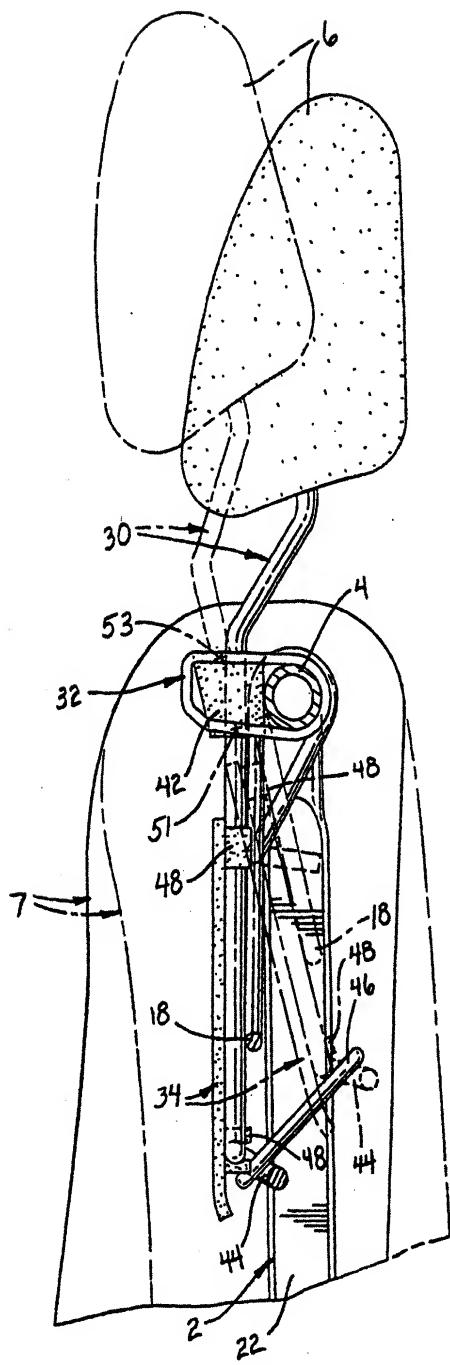


Fig. 4



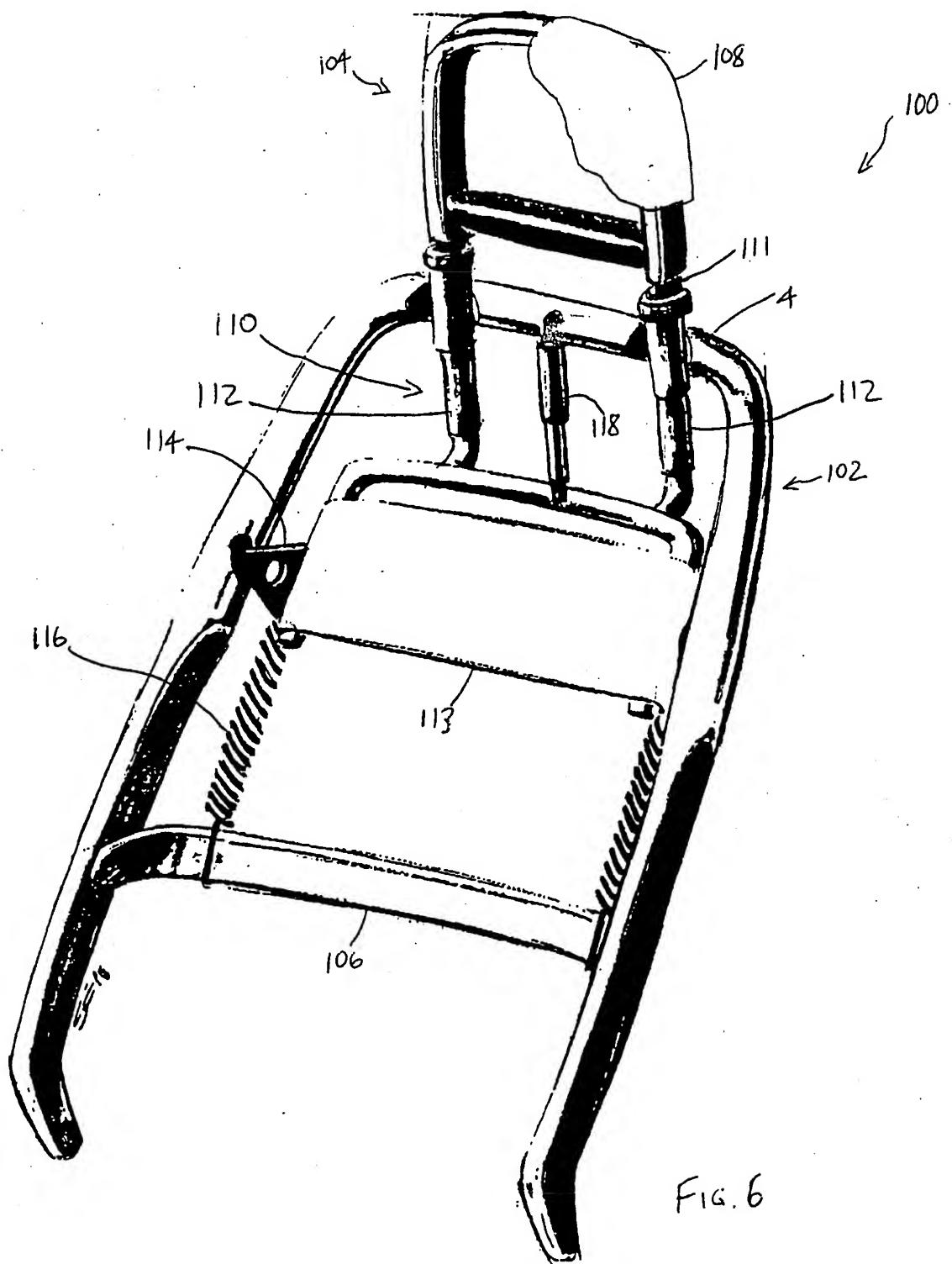
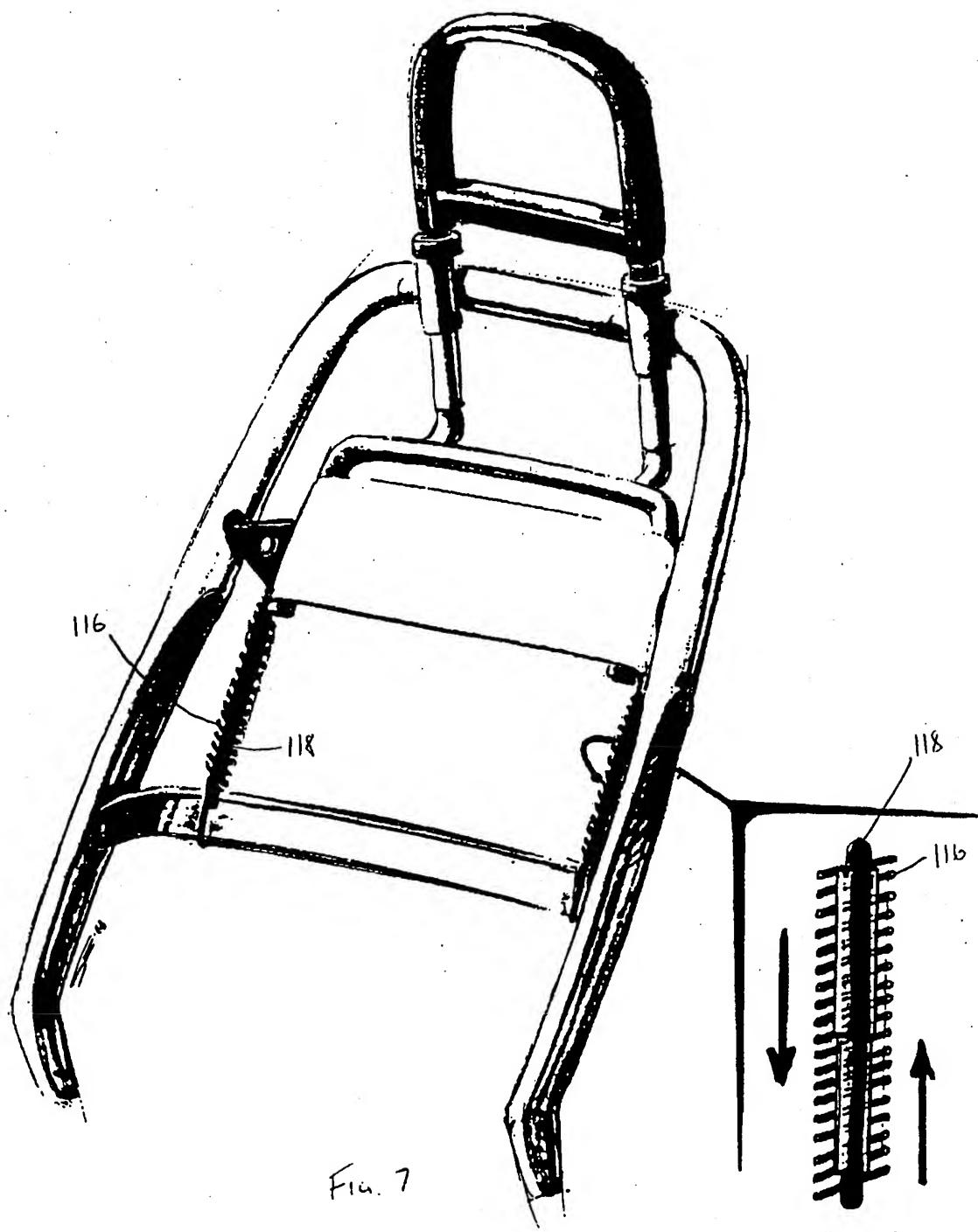


FIG. 6

5/6



6/6

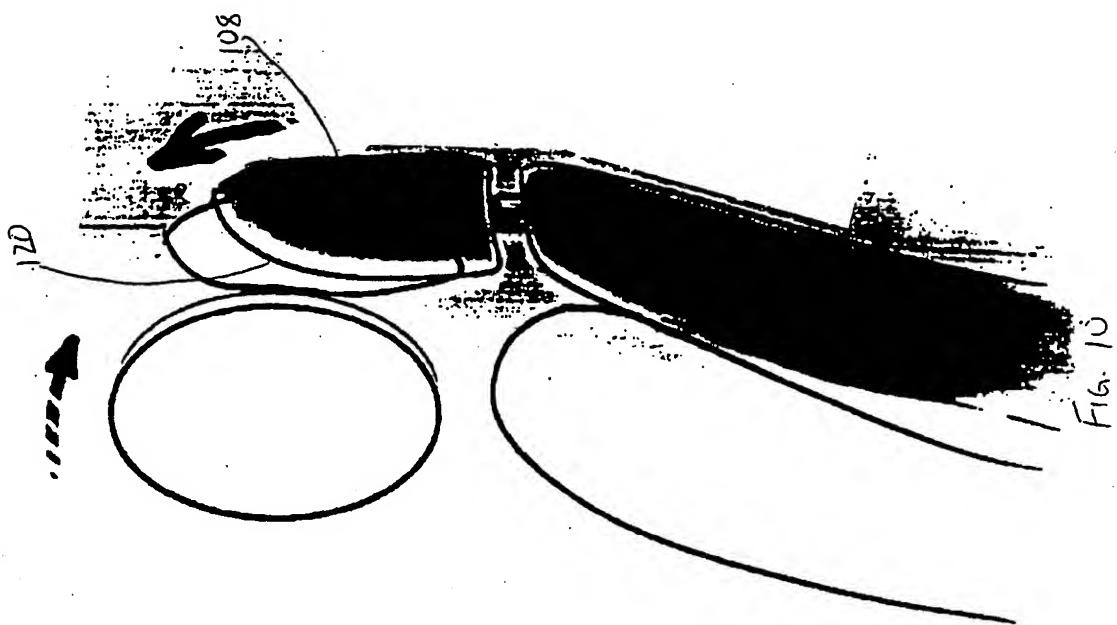


Fig. 10

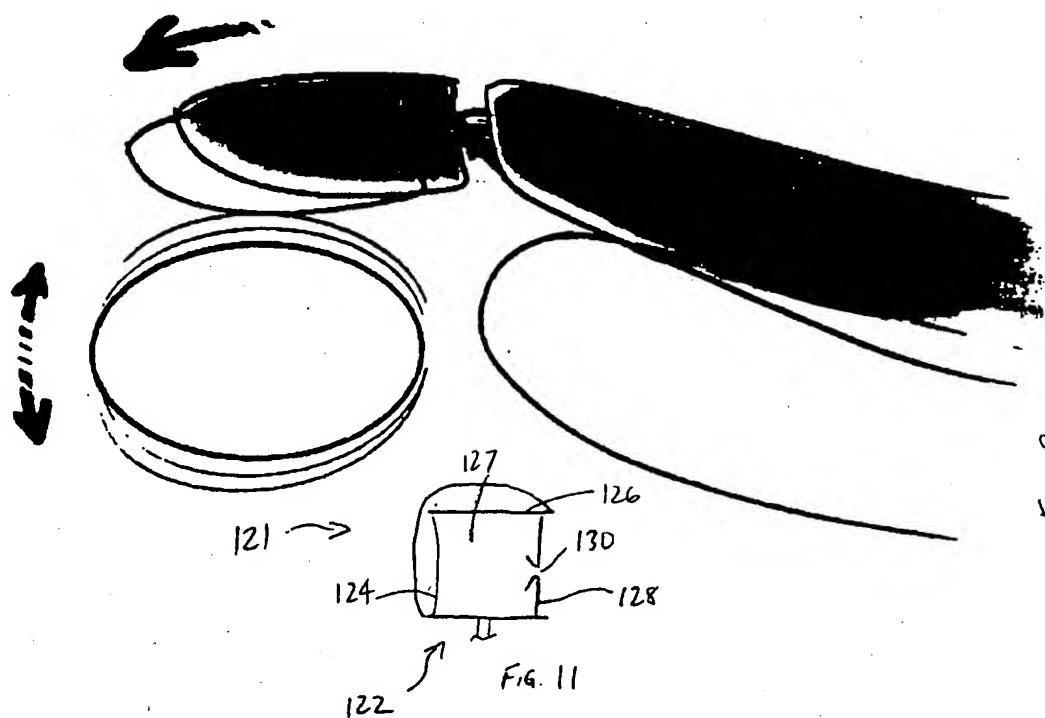


Fig. 9

FIG. 11

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 99/29681

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 860N2/48

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 860N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 772 280 A (ANDREW J. MASSARA) 30 June 1998 (1998-06-30) abstract	1,3-5,7
A	column 4, line 35 - line 36; figures 1-4 ---	2
X	DE 21 52 437 A (ADAM OPEL AG) 26 April 1973 (1973-04-26)	1,3-5
A	claims 1-7; figures 1,2 ---	2,7
A	DE 21 52 202 A (ADAM OPEL AG) 26 April 1973 (1973-04-26) page 6, line 13 -page 7, line 15; claims 1-19; figures 1-8 ---	1-7
A	WO 98 09838 A (SAAB AUTOMOBILE AB) 12 March 1998 (1998-03-12) claims 1-7; figures 1-4 ---	1,2,5,7
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"Z" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

3 April 2000

11/04/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Cuny, J-M

## INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 99/29681

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 98 16406 A (ANDONOV, ACEN) 23 April 1998 (1998-04-23) page 5, line 12 -page 6, line 16; figure 6 -----	1,5-7
A	US 5 378 043 A (DAVID C. VIANO ET AL.) 3 January 1995 (1995-01-03) cited in the application abstract column 1, line 31 -column 2, line 45; claims 1-3; figures 1-5 -----	1,2,5,7

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 99/29681

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 5772280	A 30-06-1998	NONE		
DE 2152437	A 26-04-1973	NONE		
DE 2152202	A 26-04-1973	NONE		
WO 9809838	A 12-03-1998	SE 510735 C DE 19781948 T SE 9603238 A		21-06-1999 15-07-1999 07-03-1998
WO 9816406	A 23-04-1998	NO 964371 A AU 4728597 A		15-04-1998 11-05-1998
US 5378043	A 03-01-1995	DE 69406189 D DE 69406189 T EP 0627340 A		20-11-1997 12-02-1998 07-12-1994